NON-PUBLIC?: N
ACCESSION #: 9412050260
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Grand Gulf Nuclear Station PAGE: 1 OF 5

DOCKET NUMBER: 05000416

TITLE: Reactor Scram While Performing Reactor Protection System Surveillance
EVENT DATE: 11/01/94 LER #: 94-011-00 REPORT DATE: 12/01//94

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

A reactor scram occurred on November 1, 1994 while plant maintenance personnel were performing a quarterly surveillance on the reactor protection system. All control rods inserted fully and vessel level was maintained with the reactor feedwater pumps.

Causes of the event were determined to be the ground detection circuit for the Division 1 125 VDC system which had been modified recently in conjunction with a bolted ground fault on the Division 1 backup scram solenoid valve. The bolted fault was found to be on the negative pole lead of the solenoid located at its pigtail condulet. The modification of the ground detection circuit was determined to increase the sensitivity of system components to ground faults which could result in inadvertent actuations. While the ground detection system modification had focused on the safety design basis, it failed to consider potential operational impact such as inadvertent actuations upon postulated ground

faults.

Immediate corrective action included repairing the bolted ground fault on the negative pole lead for the valve's coil. Also, the continuous monitoring ground detection circuit of the 125 VDC ground detection system was eliminated to preclude similar adverse consequences. Local periodic monitoring for system grounds was not affected by eliminating the continuous monitoring circuit. Long term corrective actions will evaluate modification of continuous monitoring circuits in all Class 1E DC ground detection systems.

This incident did not impair the ability of any system to perform its safety function. Health and safety of the public were not compromised by this event.

END OF ABSTRACT

A. Reportable Occurrence

A reactor scram occurred on November 1, 1994, during performance of quarterly surveillance 06-IC-1B21-Q-1002-1, Reactor Vessel High Pressure (RPS/RHR Shutdown Cooling Isolation) Functional Test. The scram was initiated by the reactor protection system (RPS) JC! as an indirect result of performing the surveillance. This event is considered to be an engineered safety feature (ESF) actuation, reportable pursuant to 10 CFR 50.73(a)(2)(iv).

B. Initial Condition

The plant was in Operational Condition 1 at 100 percent power with reactor pressure at approximately 1033 psig and steam temperature at 537 degrees F. An undetected bolted ground fault was present on the Division 1 backup scram valve. The ground detection circuit for the Division 1 125 VDC system had been modified prior to performing the surveillance and returned to service a few hours before the scram. The quarterly test for Division 1 RPS control logic was in progress at the time of the event. The surveillance was being performed using approved instructions.

C. Description of Occurrence

At the time of the event, the surveillance for Division 1 RPS control logic was being performed by station maintenance staff with support from operations personnel.

The surveillance directed the initiation of a Division 1 RPS scram signal. The scram signal generates audible and visual alarms, while demonstrating system operability. Immediately prior to initiating the Division 1 scram signal, control room indications were inspected for other existing scram alarms. Based on observed indications, no adverse effects from the performance of the surveillance were expected. Upon initiating the scram signal, alarms and indications were received as specified by the procedure. However after initiation, an unanticipated alarm occurred indicating a scram pilot valve air header low pressure. Control rods began inserting (i.e., scramming in) upon loss of pressure in the air header. Shortly thereafter, a Division 2 RPS scram signal was received due to low reactor vessel water level. This resulted in a full RPS actuation.

The plant was stabilized in accordance with approved plant procedures. High levels in the low pressure feedwater heaters caused isolation of the feedwater flow path which resulted in a trip of the operating reactor feedwater pump (the other pump had been manually tripped as a part of stabilization). Operators restored the flow path and water level was controlled using the feedwater system SJ!. Vessel level increased to approximately +53 inches where the feedwater pump tripped on high reactor vessel water level. No actuation of emergency core cooling systems (ECCS) was required during this transient.

D. Investigation Results

Immediate investigation of the event revealed that the loss of pressure in the scram pilot valve air header was the result of backup scram valve 1C11F110A opening. 1C11F110A, a direct acting solenoid valve powered by the Class 1E 125 VDC system EJ!, opened when the Division 1 scram signal was initiated in accordance with the surveillance. The backup scram valve should not have been affected by performance of any portion of this surveillance.

The incident investigation identified two major causal factors, a grounded lead on the backup scram solenoid and the design of a recently implemented modification.

1C11F110A opened as a result of a bolted ground fault on the negative lead of its solenoid and the reduced resistance between bus 11 DA's poles and ground provided by a design modification. The grounded lead was found to be the negative conductor of the solenoid's control cable. This conductor was pinched between the condulet cover and the condulet where the solenoid's pigtails are spliced to its control cable. The coil for

solenoid valve 1C11F110A is isolated from its power source (Division 1 125 VDC Bus 11DA) by RPS trip system A contacts on its positive terminal side and an RPS trip system B contacts on its negative terminal side. The grounded lead in conjunction with Bus 11DA's ground detection circuit provided a path around the solenoid coil's RPS B contact. Apparently, the grounded lead was the result of previous maintenance activities associated with the valve.

Performance of the surveillance prior to the modification did not result in adverse plant response. Investigation of the scram event found that Bus 11 DA's ground detection scheme had been modified and returned to service on November 1, 1994. Subsequent testing of the modification found that the implemented design increased the ground detection circuit's sensitivity such that bolted ground faults could cause the backup scram valve to actuate.

The modification had reduced the designed resistance between ground and each pole of the ungrounded 125 VDC system to support the function of the new ground detection relay. The ground detection circuit's design, in conjunction with the bolted ground fault allowed sufficient voltage to drop across the valve's solenoid upon initiation of the Division 1 scram signal to cause valve operation.

The industry standard used at the time of design preparation (IEEE 946-1985) did not incorporate appropriate measures to prevent inadvertent actuations (energizing or deenergizing) of DC system loads by postulated ground faults. The design for the ground detection circuit focused on the safety design bases as noted in NRC Information Notice 88-86. However, considerations for potential operational impact were not addressed. Even though a revised standard (IEEE 946-1992) incorporated the concept, its methodology relies on the manufacturer's stated minimum operating voltage to determine postulated system responses. Investigation of the event revealed the valve's solenoid operated with a minimum operating voltage less than that specified by the valve's vendor. The valve vendor specified a minimum operating voltage of 90 VDC. Following the reactor trip, evaluation of the modified ground detection system's design determined that the design limited the voltage across 1C11F110A's coil to less than 38 VDC. Therefore, analysis of postulated faults during the modification's design process may not have prevented the event.

E. Corrective Actions

Immediate corrective action included repairing the bolted ground fault on

the field cable for 1C11F110A's coil. Also, the continuous ground detection circuit for the 125 VDC system was eliminated to preclude similar adverse consequences. Local ground detection monitoring capability was not affected by elimination of the continuous ground detection monitoring circuit. Long term corrective actions will evaluate modification of the continuous ground detection monitoring circuits for all Class 1E 125 VDC systems.

F. Additional Information

Investigation into the event revealed additional contributing causes. Control systems for plant equipment feature intrinsic "islands" in control circuits. These islands are isolated from the ground detection system until a control system contact closes such as during a surveillance. The plant computer system ID! provides a means to detect ground faults via plant computer points, including those within "islands" when an "island" circuit is actuated. However, the malfunctioning relay in the original ground detection circuit caused the computer ground detection alarms to be unreliable. Replacement relays were no longer available, thereby necessitating a design change to the circuit.

IN 88-86 demonstrates the importance of monitoring and promptly clearing grounds on ungrounded DC systems. GGNS review of IN 88-86 did not effectively emphasize the need for these practices. GGNS system design, and operating and maintenance practices will be evaluated for optimization with respect to prompt identification, assessment, and correction of ground faults, consistent with the philosophy promulgated by IN 88-86.

Energy Industry Identification System (EIIS) codes are identified in the text within brackets !.

G. Safety Assessment

This incident did not impair the ability of any system to perform its safety function. Minimum water level in the reactor vessel was recorded at -20 inches narrow range which corresponds to approximately 147 inches above the top of active fuel. No emergency core cooling systems (ECCS) were required to operate during the plant transient. No safety relief valves actuated. ECCS systems were available to perform their safety function. Design reviews for the ground detection circuit provided assurance that safety system performance would be adequate. Health and safety of the public were not compromised by this event.

ATTACHMENT TO 9412050260 PAGE 1 OF 1

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December 1, 994 Vice President
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U.S. Nuclear Regulatory Commission
Mail Station P1-137
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Attention: Document Control Desk

SUBJECT: Grand Gulf Nuclear Station
Unit 1
Docket No. 50-416
License No. NPF-29
Reactor Scram While Performing Reactor Protection
System Surveillance
LER 94-011-00

GNRO-94/00140

Gentlemen:

Attached is Licensee Event Report (LER) 94-011 which is a final report.

Yours truly,

CRH/MJM/CAB/BAB
attachment
cc: Mr. J. E. Tedrow (w/a)
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Mr. R. B. McGehee (w/a)
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